Congleton and Matlock to the south, embracing portions of five counties, and sources of several head-streams of the Mersey, Dee, Trent, and Yorkshire Ouse.

There are several elevations of a little more than 2000 feet, and a large proportion of the district consists of unenclosed moorland and grassland. The maps are coloured to show the plant formations of acidic peat, siliceous soil, calcareous soil, sandy soil, and of cultivated land. The plant formations are subdivided into associations. For example, the formation of acidic peat exhibits associations in which *Vaccinium Myrtillus*, *Eriophorum vaginatum*, *Calluna vulgaris* respectively dominate, and others in which two of these units are more or less equally dominant.

Following an introduction, dealing, among other things, with rainfall, temperature, and winds, are chapters on woodland, scrub, grassland, moorland, rocks and screes, marsh, and aquatic and cultivated land associations. Summaries of the plant communities (these include formations and associations) of the Peak district and of Britain conclude a most interesting book, the illustrations and maps of which are excellent. W. B. H.

Outlines of Stationery Testing. A Practical Manual. By H. A. Bromley. Pp. 74. (London: C. Griffin and Co., Ltd., 1913.) Price 2*s*. 6*d*. net.

THIS little manual deals chiefly with the technical examination of paper, though other articles of stationery are included in its scope. It avoids theoretical considerations, and gives in simple language concise instructions for the practical testing of paper, physically, microscopically, and chemically. Under the first heading come questions of colour, nature of the paper, surface or "finish," texture, opacity, ink-bearing properties, and strength. Short notes are supplied explaining these terms as applied to paper, and the methods of testing the properties indicated by them.

Few words are wasted in the chapter devoted to explaining the microscopic examination of paper. The author has managed to condense the description of the examination into five small pages, whilst another five are allotted to plates showing the microscopic characters of the principal fibres.

Under the head of chemical examination, directions are given for determining the nature and amount of the mineral matter used as "loading," and of the organic substances, such as gelatine, rosin, casein, and starch, employed in the "sizing" of paper. Methods are also propounded for discriminating the colouring ingredients and detecting chemically certain fibres and impurities. In all cases, the author claims, the chemical processes described are those which require the simplest possible apparatus. The characteristics of special kinds of paper are indicated briefly, and the book concludes with short sections on the testing of ink, gum, sealing-wax, and other miscellaneous articles included in the term "stationery." Within its limits—those of a collection of notes for use in practically examining stationery—the book will be found useful.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Pianoforte Touch.

I CAN fully endorse Dr. Heaviside's opinions as to the possibilities of the piano-player, and could only wish that there were some reasonable prospect of this instrument being used to save a great portion of the uninteresting drudgery of the usual school music-lesson. At the present time a considerable amount of school time is wasted in attempting to learn an instrument which is so difficult to play that few succeed in obtaining any satisfactory results. This system does not succeed in producing musicians any better than the ordinary school algebra lesson succeeds in producing mathematicians.

On the other hand, my recent experiments in connection with this "patent" control have led me carefully to test the existing commercial piano-players, and I can fully endorse Mr. Wheatley's complaints as to their lack of responsiveness and their persistent assertion of their mechanical individuality in opposition to the most strenuous efforts of the performer controlling them. The methods of varying expression by means of punch-holes, or by damping down all the notes on one side or other of a hard and fast dividing line, produce a very pleasing impression at first, but one soon tires of their very limited capabilities.

In these circumstances I would strongly recommend Mr. Wheatley and any other readers of NATURE who are interested in the subject to experiment with the methods of control claimed in my patent specifications. Even a rough and ready device rigged up with sticks, strings, and kitchen weights produces such a great improvement in the range of effects and flexibility of the instrument that after experimenting with such an arrangement I found it impossible to obtain any satisfaction without it. I think it may be safely said that the mechanical self-assertiveness of the instrument can be reduced to a small quantity of the second order, and can be further reduced by a method of successive approximation. So soon as dynamical considerations are introduced the possibility of accenting notes in *chords* (*i.e. proper chords*, not the miserable arpeggios which are so often substituted for them in recently cut music rolls) becomes evident, and the production of variations of tone quality by differences of touch is probably much easier when effected this way than when the keys are played by hand. All this appears less difficult to learn than the control of the speed regulator, which must always remain a difficulty.

The absence of these capabilities constitutes the great defect of the commercial player. But the ordinary "practical man" cannot understand anything based on the principles of dynamics and physics, consequently he treats the pressure as if it were constant instead of a very variable function of the time, and the result is an instrument which is mechanical and little else, and can only be played with an unnecessary expenditure of energy.

I have heard a professional pianist perform a very delicate *pianissimo* passage in which the accented notes rang out clearly and brilliantly above the background without being played any louder. It was simply a difference of tone quality produced by a corresponding difference of touch. My dynamically-controlled piano-player is quite capable of giving a

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very approximate reproduction of this effect, whereas I have heard an expert break down hopelessly over a similar passage at an exhibition recital of a commercial machine.

With regard to the connection between tone quality and touch, I do not think Dr. F. J. Allen's explanation meets the case. Unless there is distinct experimental evidence to the contrary, I do not think we ought to exclude the *possibility* of a double or multiple impact between the hammer and string; indeed, some of my experiences favour this hypothesis. But I am inclining more and more to the belief that the differences may be largely due to the elasticity and inertia of the stem of the hammer. The introduction of these elements converts the hammer into a dynamical system capable of independent vibration. The method of normal coordinates then enables us to represent this system by a simpler system having the same vibration periods; for example, a system of two or more particles connected by elastic springs and moving in a straight line. It is clear that the duration of contact of a pair of such particles with the wire will depend largely on the state of compression between them and their relative velocity at the instant of impact. The interval between the release of the hammer and its striking the wire is probably short compared with the time of a free oscillation of the hammer itself, and certainly short compared with the time in which such an oscillation would die out. On setting the hammers of the horizontal piano low down, the variations of tone quality entirely disappear, as one would expect.

I find another favourable condition by developing Kaufmann's method in connection with the problem of a single inelastic particle striking a wire near one end. The duration of contact is determined by the vanishing of a function which has one or more minimum values before it actually vanishes, some of these being small. A very small difference in the assumed conditions might therefore convert one of these minimum values into a negative value. Remembering that such assumed conditions are probably not even approximately satisfied in practice, we still have a result indicating that the pianoforte hammer and string may be highly susceptible to any cause which tends to vary their duration of contact.

I am specially pleased to receive Dr. Heaviside's views on this subject, and to find that he has been long interested in these difficult problems.

Since writing this I have read Prof. Morton's letter, and am very glad to receive his references to previous work on the subject. With regard to his own experiments, I think something more is necessary for my purpose than what he mentions in NATURE, namely a comparison of the striking velocities of pianoforte hammers in *different* parts of the scale. I notice Prof. Morton does not mention what particular notes were struck in his observations. It would also be important to compare the striking velocities for two notes, one in the treble and one in the bass, when simultaneously excited by a common pneumatic impulse of long or short duration, such as can be produced in these piano-player experiments with properly cut chords. With regard to the other question, I think it is unfortunate that authors like Matthay have used the terms "good" and "bad" touch in this connection. I freely admit that the heavy, inelastic impacts produced by the inexperienced performer produce such a harsh effect as to be very objectionable (and possibly this may be due to Dr. Allen's so-called "xylophone" effect); on the other hand, any playing sounds to me mechanical which does not involve considerable variation of tone quality. This appears to me to be particularly necessary in studying piano arrangements of orchestral music, where the sharp, metallic tones of the brass instruments have to be brought out in contrast to the softer tones of the strings. Possibly when fingers are used the pianist usually has too many other matters requiring his attention. But whether a metallic effect is "good" or "bad" must depend on how and when it is used, and personally I should think a constant tone quality the worst effect of all. Prof. Morton's letter, however, raises a number of other questions which would take a long time to answer, and may have to be explained in subsequent correspondence.

G. H. BRYAN.

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Mackerel and Calanus.

WE all believe that most of our common food-fishes at some stage of life feed upon plankton, but those who have looked into sea-fisheries questions know that there is a great want of actual observations connecting the occurrence of some planktonic organism in quantity with the presence of a particular fish. Consequently the following record may be of interest to both marine biologists and fisheries experts.

We are out on a scientific fisheries cruise, and in addition to members of my own family, two well-known naturalists, Prof. Newstead and Mr. Alfred O. Walker are with us on the yacht, and we have just had what we regard as a satisfactory demonstration of the connection between a large shoal of mackerel and the occurrence of *Calanus finmarchicus* in unusual quantity.

On arriving in this bay last night we found that the local boats had been catching abundance of mackerel close to. We bought some for supper (good fish for a halfpenny each), and on dissection found that the stomachs of all of them were crammed full of fresh-looking Calanus (the individual Copepods being for the most part distinct and perfect), along with a few immature Nyctiphanes and larval Decapods. Prof. Newstead and my daughter then noticed, while fishing over the side of the yacht, about 8 p.m., that the gulls in the bay were feeding in groups around patches of agitated water evidently caused by shoals of fish. On rowing out to these we saw distinctly the mackerel, large and small, darting about in great numbers in the clear water, and we also noticed every here and there on the smooth surface of the water—it was a beautifully calm evening—innumerable small whirls or circular marks which, on looking closely, I found to be caused by large Copepoda close to the surface.

About twenty years ago I sent a note to NATURE, from the yacht *Argo*, in regard to large Copepoda (I think it was Anomalocera on that occasion, and the locality was further north, off Skye) splashing on the surface so as to give the appearance of fine rain; and this present occurrence at once reminded me of the former occasion, but here the Copepod was *Calanus finmarchicus* of large size and in extraordinary abundance. They could be clearly seen with the eye on leaning over the side of the boat, a small glass collecting jar dipped at random into the water brought out twenty to thirty specimens at each dip, and a coarse grit-gauge tow-net of about 34 cm. in diameter caught about 20 cubic centimetres of the Copepoda in five minutes. The mackerel were obviously darting about, occasionally leaping to the surface (which gave the gulls their opportunity) where the whirls caused by the Copepoda were thickest, and an examination of the stomach-contents of the fish on the yacht afterwards showed us that the amount in one mackerel was about the same quantity as that caught by the tow-net in five minutes. Prof. Newstead and I have made a count of 8 c.c. of the tow-net gathering, and estimate that it contains about 2400 specimens of

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